PATENT

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

Applicant:	Jerry W. Schoen et al	: Paper No:	
Serial No.	09/847,236	: Group Art Unit:	1793
Filed:	05/02/2001	: Examiner:	John P. Sheehan

For: HIGH PERMEABILITY GRAIN ORIENTED ELECTRICAL STEEL

RESPONSE AND AMENDMENT

Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Office Action mailed August 3, 2010, Applicant submits the following amendments and remarks.

Amendments to the Claims begin on page 2 of this paper.

Amendments to the Specification begin on page 8 of this paper.

Remarks begin on page 9 of this paper.

AMENDMENTS TO THE CLAIMS:

The following listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) A method for producing a high permeability grain oriented electrical steel, consisting essentially of the steps of:

providing a strip having a thickness of from about 1.5 to about 4 mm,

the strip composition comprising about 2.0 to about 4.5% silicon, greater than 0.25 to about 1.2% chromium, about 0.01 to about 0.08% carbon, about 0.01 to about 0.05% aluminum,

the strip having a volume resistivity of at least about 45 μΩ-cm, and an austenite volume fraction (γ1150°C) of at least about 20%,

annealing said strip to provide an isomorphic layer thickness of at least about 2% of the total thickness of the annealed strip,

rapidly cooling the annealed strip to ensure that the austenite is transformed into a hard second phase,

cold rolling the cooled and annealed strip in one or more stages to provide a cold rolled strip, said cold rolling providing a final reduction of at least 80%,

~~annealing the cold rolled strip,~~

decarburization annealing the cold roll strip sufficiently to prevent magnetic aging,

coating at least one surface of the decarburization annealed strip with an annealing separator coating, and

final annealing the coated strip to effect secondary grain growth and thereby provide a permeability measured at 796 A/m of at least 1840.

2. (Original) The method claimed in claim 1 wherein the composition comprises up to about 0.1% sulfur, up to about 0.14% selenium, about 0.03 to about 0.15% manganese, up to about 0.2% tin, and up to about 1% copper.

3. (Original) The method claimed of claim 1 wherein the isomorphic layer has a thickness of at least about 4% on at least one side of said strip.

4. (Original) The method claimed in claim 1 wherein the austenite volume is about 20 to about 40%.

5. (Original) The method claimed in claim 1 wherein the austenite volume is about 25 to about 35%.

6. (Original) The method claimed in claim 1 wherein the cold rolling is done in a single stage and the final cold reduction is at least about 85%.

7. (Currently Amended) The method claimed of claim 1 wherein a microstructure of the strip prior to the cold rolling to the final thickness consists of a ferrite matrix having more than 1 vol.% of martensite and/or retained austenite and the strip prior to the cold rolling to the final thickness has a carbon content of at least 0.020%.

8. (Original) The method claimed of claim 1 wherein the volume resistivity is at least about 50 μΩ-cm.

9. (Original) The method claimed of claim 1 wherein the carbon is about 0.03% to about 0.06%.

10. (Original) The method of claim 1 wherein the chromium is greater than 0.25% to about 0.75%.

11. (Original) The method claimed of claim 1 wherein the chromium is greater than 0.3% to about 0.5%.

12. (Original) The method claimed of claim 1 wherein the silicon is about 2.75% to about 3.75%.

13. (Original) The method claimed of claim 1 wherein the silicon is about 3.0% to about 3.5%.

14. (Original) The method of claim 1 wherein the aluminum is 0.02% to about 0.03%.

15. (Previously presented) The method of claim 1 wherein the strip composition further comprises about 0.05% to about 0.09% manganese.

16. (Previously presented) The method of claim 1 wherein the strip composition further comprises about 0.05% to about 0.1% tin.

17. (Previously presented) The method of claim 1 wherein the strip composition further comprises about 0.02% to about 0.03% sulfur or selenium.

18. (Previously presented) The method of claim 1 wherein the strip composition further comprise about 0.05% to about 0.15% copper.

19. (Original) The method of claim 1 wherein the carbon is decarburized to a level below about 0.003%.

20. (Original) The method of claim 1 wherein the annealing after the decarburizing anneal includes a rapid heating at a rate greater than about 100°C/second.

21. (Withdrawn) A method of initial annealing a high permeability grain oriented electrical steel band, said method comprising the steps of:

providing a grain oriented electrical steel band comprising about 2.0 to about 4.5% silicon, about 0.1 to about 1.2% chromium, about 0.01 to about 0.08% carbon, about 0.01 to about 0.05% aluminum, about 0.003 to about 0.013% nitrogen and balance essentially iron and residual elements,

heating said band at to a temperature greater than about 1150°C,

providing a soak for at least 1 second at a peak temperature greater than about 1150°C,

slow cooling said band from said soak temperature to temperature below about 1000°C to about 870°C, and

quenching said band at a rate greater than 30°C/second from said final slow cooling temperature at a start quench temperature to a temperature below 400°C to prevent tempering of martensite, said quench start temperature being selected based on the chromium content.

22. (Withdrawn) The method of claim 21 wherein the band is cooled at a rate greater than 20°C/second from 400°C to below 100°C.

23. (Withdrawn) The method of claim 21 wherein said band is cooled at a rate greater than 40°C/second from said final slow cooling temperature at said start quench temperature to a temperature below 400°C.

24. (Withdrawn) A method for producing a high permeability grain oriented electrical steel, comprising the steps of:

providing a band having a thickness of from about 1.5 to about 4 mm,

the band composition comprising about 2.0 to about 4.0% silicon, about 0.1 to about 1.2% chromium, about 0.01 to 0.03% carbon, about 0.01 to about 0.05% aluminum and balance being essentially iron and residual elements,

the band having a volume resistivity of at least about 45 μΩ-cm, and an austenite volume fraction (γ1150°C) of at least about 20%.

annealing said hot rolled band to provide an isomorphic layer thickness of at least about 2% of the total thickness of the hot processed band,

cold rolling the band in one or more stages to provide a cold rolled strip, said cold rolling providing a final reduction of at least 80%,

annealing the cold reduced strip,

decarburization annealing the cold reduced strip sufficiently to prevent magnetic aging,

nitriding said decarburized strip,

coating at least one surface of the annealed strip with an annealing separator coating, and

final annealing the coated strip to effect secondary grain growth and thereby provide a permeability measured at 796 A/m of at least 1840.

25. (Withdrawn) The method of claim 24 wherein said chromium content is greater than 0.25% to about 1.2%.

26. (Withdrawn) The method of claim 24 wherein said chromium content is greater than 0.30% to about 1.2%.

27. (Withdrawn) A method for producing a high permeability grain oriented electrical steel, comprising the steps of:

providing a band having a thickness of from about 1.5 to about 4 mm,

the band composition comprising about 2.0 to about 4.5% silicon, greater than 0.1 to about 1.2% chromium, about 0.02 to about 0.045% carbon, about 0.01 to about 0.05% aluminum and balance being essentially iron and residual elements,

the band having a volume resistivity of at least about 45 μΩ-cm, and an austenite volume fraction (γ1150°C) of at least about 20%,

annealing said hot rolled band to provide an isomorphic layer thickness of at least about 2% of the total thickness of the hot processed band,

cold rolling the band in one or more stages to provide a cold rolled strip, said cold rolling providing a final reduction of at least 80%,

annealing the cold reduced strip,

decarburization annealing the cold reduced strip sufficiently to prevent magnetic aging,

nitriding said decarburized strip,

coating at least one surface of the annealed strip with an annealing separator coating, and

final annealing the coated strip to effect secondary grain growth and thereby provide a permeability measured at 796 A/m of at least 1880.

28. (Withdrawn) The method of claim 27 wherein said chromium is greater than 0.25% to about 1.2%.

29. (Withdrawn) The method of claim 27 wherein said chromium is greater than 0.30% to about 1.2%.

AMENDMENT TO THE SPECIFICATION

Please amend lines 7 – 12, as previously amended, of page 12 of the application as follows:

~~The thickness of surface isomorphic layer can be calculated using Equation (3):~~

$$(3) \quad I = 1/t^{0.5} \cdot [2.368 - 0.02(\%\gamma_{1150°C}) - 0.527(\%Si)]$$

~~where I is the thickness of the surface isomorphic layer in mm, $\gamma_{1150°C}$ is the calculated austenite volume fraction in the band prior to cold rolling per Equation (2), *t* is the the thicknesss of the band and %Si is the weight percent of silicon contained in the alloy.~~ The thickness of the

REMARKS

Claims 1-20 are currently pending in the application. Claims 21-29 have been withdrawn.

Specification:

The Examiner has objected to the amendment to the specification filed July 17, 2010, under 35 U.S.C. 132(a) because he stated that it introduced new matter into the disclosure. While applicants do not agree that the corrected equation (3) introduced new matter, the specification has now been amended to delete Equation (3) and the sentence containing it. As shown by the data provided in Table 1, the isomorphic layer thickness can also be physically measured, and so inclusion of equation (3) is not necessary to describe or enable the claimed invention. To eliminate an error, equation (3) has now been omitted. It is believed this does not introduce new matter and so obviates the objection.

Claim Rejections:

The Examiner has rejected claims 1 to 20 under 35 USC 112, second paragraph, as being indefinite. Specifically, he states that "[i]n claim 1, line 16, the phrase, 'the cold rolled strip' lacks a clear antecedent. He goes on to ask "does this phrase refer to the 'cold rolled strip' recited in lines 13 and 14 or does this phrase refer to the 'cold rolled strip' recited in line 15." Line 13 of claim 1 provides the step of "cold rolling the cooled and annealed strip in one or more stages to provide a cold rolled strip." (emphasis added) It is that "cold rolled strip" that is decarburization annealed in the step of line 16. Line 15 has been omitted.

Conclusion

Applicant has made an earnest effort to be fully responsive to the Examiner's objectin and rejection and believes that claims 1-20 are now in condition for allowance. Applicant solicits the allowance of these claims.

If, however, the Examiner should for any reason consider this application not to be in condition for allowance she is respectfully requested to telephone the undersigned attorney at the number listed below prior to issuing a further action.

The Commissioner for Patents is hereby authorized to charge any deficiency, including any fees required for an extension of time not already paid for or any other required fees not already paid for, or to credit any overpayment of fees, to Frost Brown Todd LLC Deposit Account No. 06-2226.

Respectfully submitted,

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